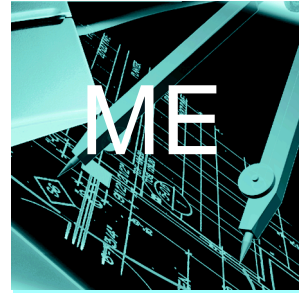


Mechanical Engineering Aids



Mechanical Engineers use a variety of mechanical drawings and computer tools for analysis and design. During the design process, drawings are used throughout to develop and document the design solution. The Design menu in the Mechanical Engineering workspace contains several commands which are useful in the creation of mechanical drawings and documentation. These commands, or scripts, all display a dialog box which contains various options, and data input boxes. Any of the commands can be added to any workspace using the Workspace Editor, refer to page 19-1, Customizing VectorWorks, in the MiniCAD VectorWorks User's Manual. This guide describes commands and items specific to the field of Mechanical Engineering.

To Use any command in this guide:

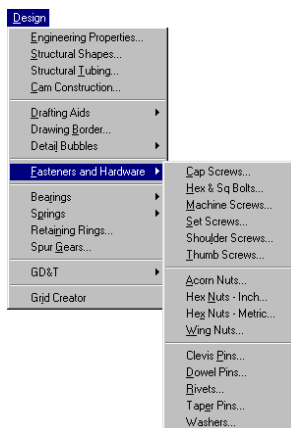
1. Select the option from the **Design Menu** in the **Mechanical Eng** workspace.

A dialog for the selected tool appears.

Enter the desired criteria.

Click **OK**.

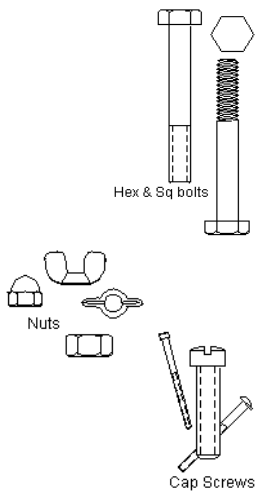
For each tool, the path is listed. For example, Design>Fasteners and Hardware>Cap Screws will access the Cap Screws command.



In this Guide

- **Fasteners & Hardware**
- **Creating Bearings**
- **Creating Springs**
- **Creating Retaining Rings**
- **Creating Spur Gears**
- **Geometric Dimensioning and Tolerancing**
- **Detail Bubbles**
- **Grid Creator**

FASTENERS & HARDWARE



Design>Fasteners and Hardware

Fasteners and Hardware devices are used on nearly every manufactured product. Many of these fasteners are manufactured in accordance with national and international standards. The Fasteners and Hardware dialog boxes display all available standard sizes per ASME standards for the selected item.

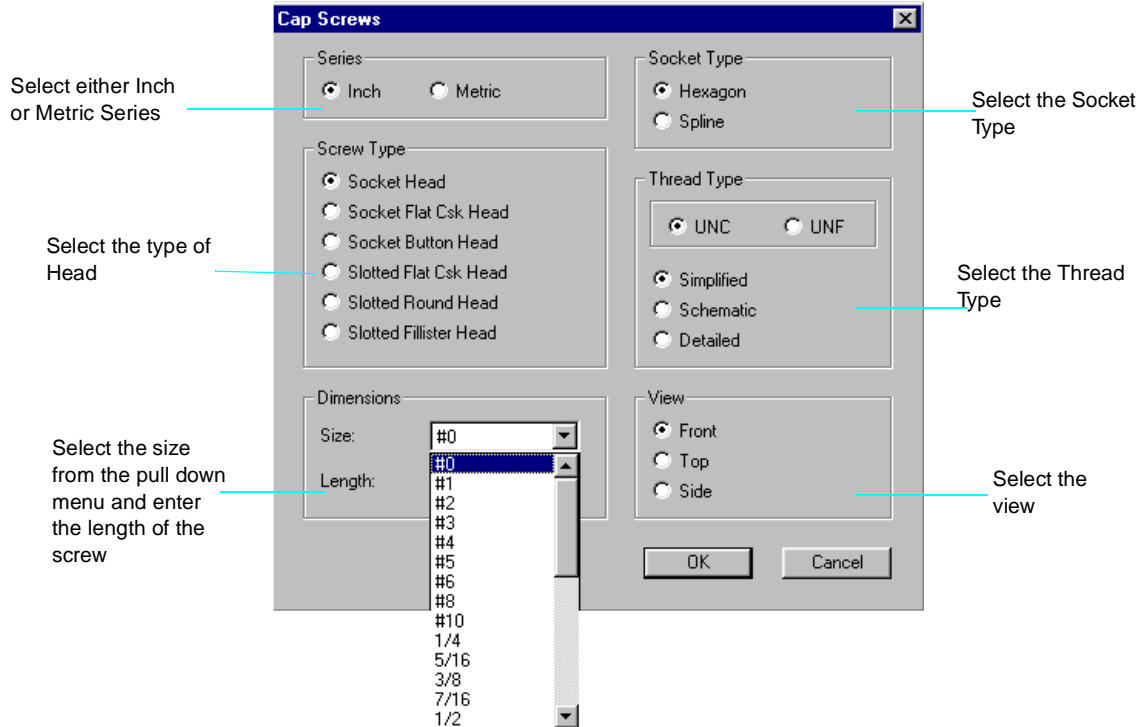
Mechanical fasteners include threaded fasteners; bolts, nuts, screws and non threaded fasteners; washers, rivets, and more. The Fasteners and Hardware command contains a list of the following scripts.

Screws	Nuts	Other
Cap Screws	Acorn Nuts	Clevis Pins
Hex & Sq Bolts	Hex Nuts - Inch	Dowel Pins
Machine Screws	Hex Nuts - Metric	Rivets
Set Screws	Wing Nuts	Taper Pins
Shoulder Screws		Washers
Thumb Screws		

Each script displays a dialog box which contains standard screw types and lists available sizes, styles, and views of that particular item. Enter your desired criteria, then click on your drawing screen to place the selected item. The following are descriptions of what the various scripts create. Since many of the dialog boxes are similar, not all are shown.

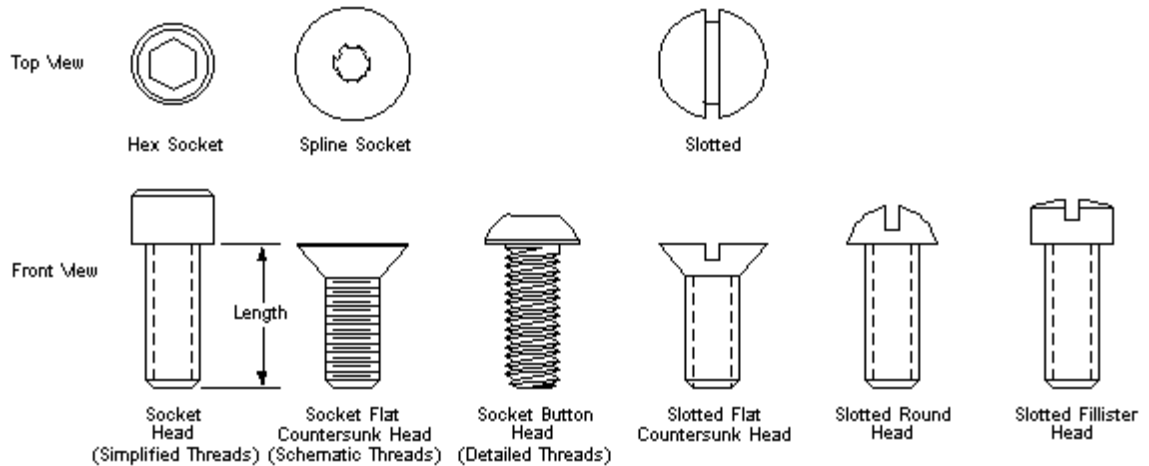
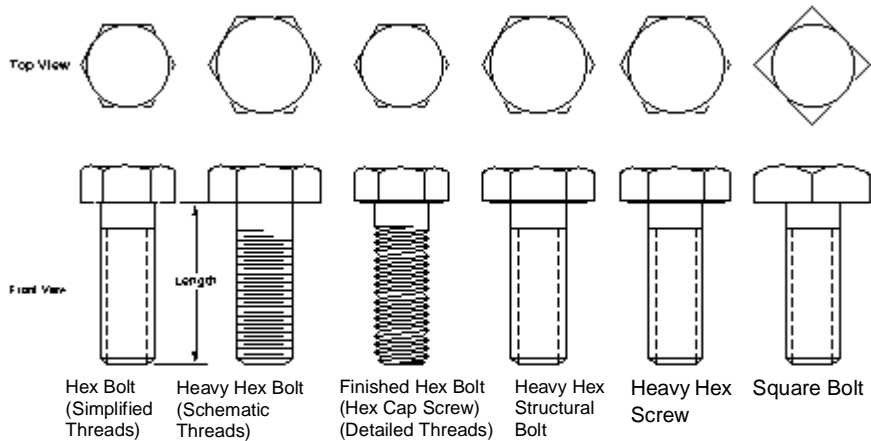
Cap Screws

Design>Fasteners and Hardware>Cap Screws



Hex and Square Bolts

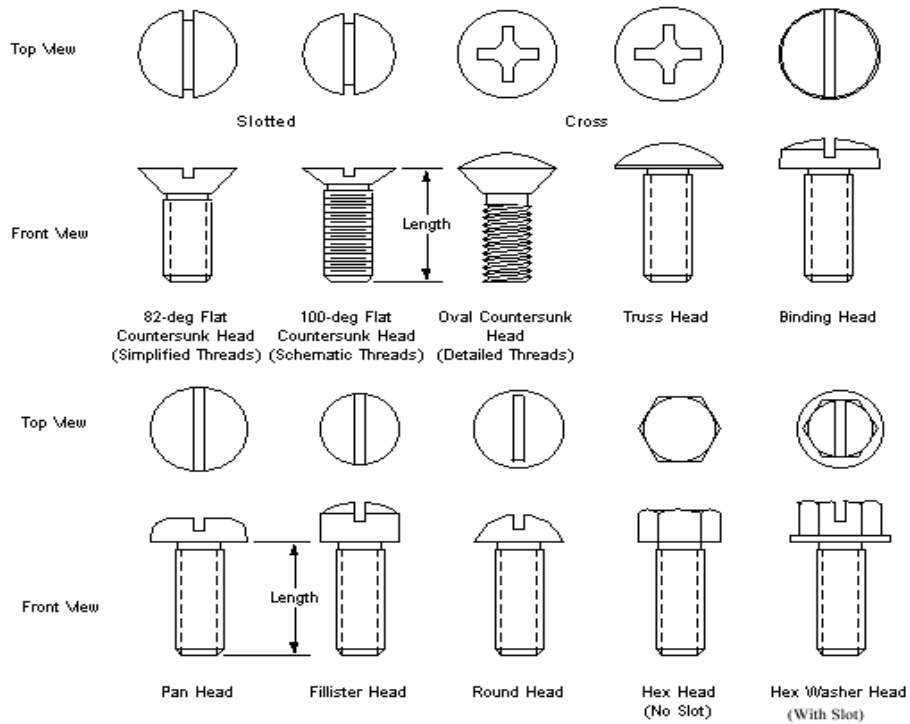
Design>Fasteners and Hardware>Hex and Sq Bolts



Cap Screws

Machine Screws

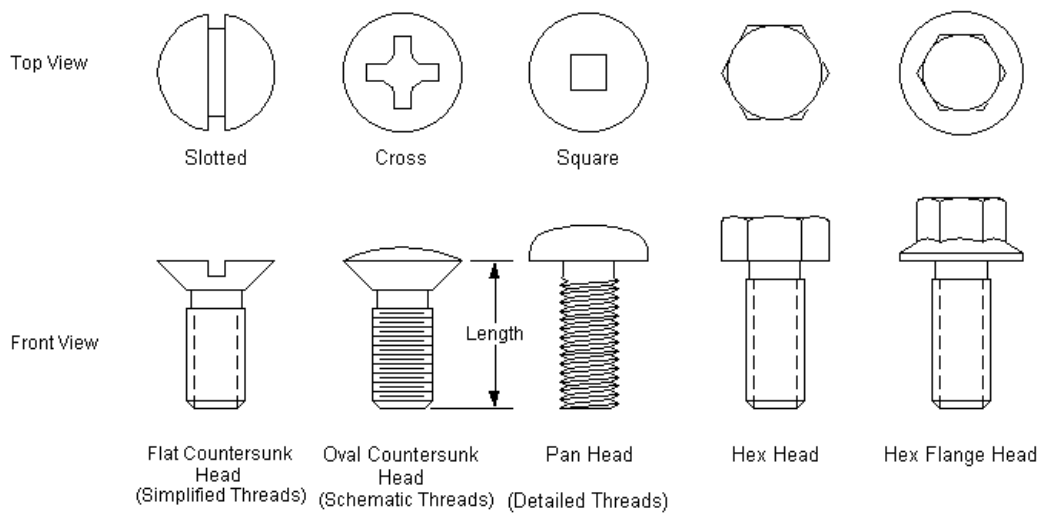
Design>Fasteners and Hardware>Machine Screws



Machine Screws - Inch Series

Fasteners & Hardware

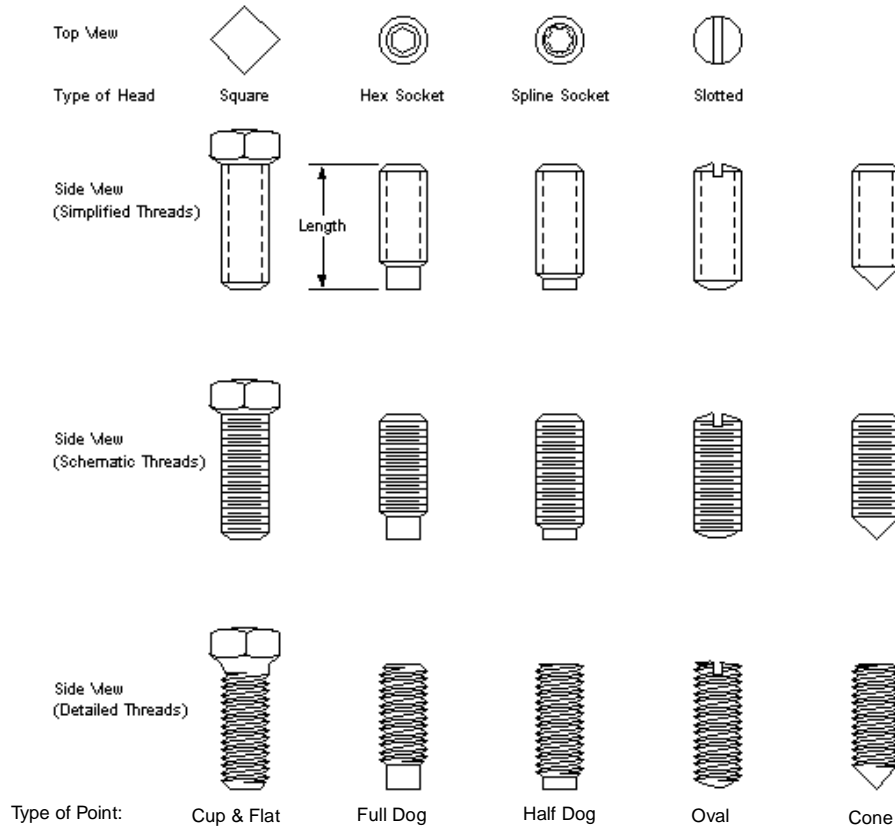
Mechanical Engineering Aids



Machine Screws - Metric Series

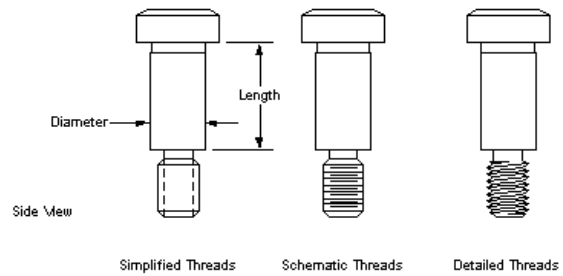
Set Screws

Design>Fasteners and Hardware>Set Screws



Shoulder Screws

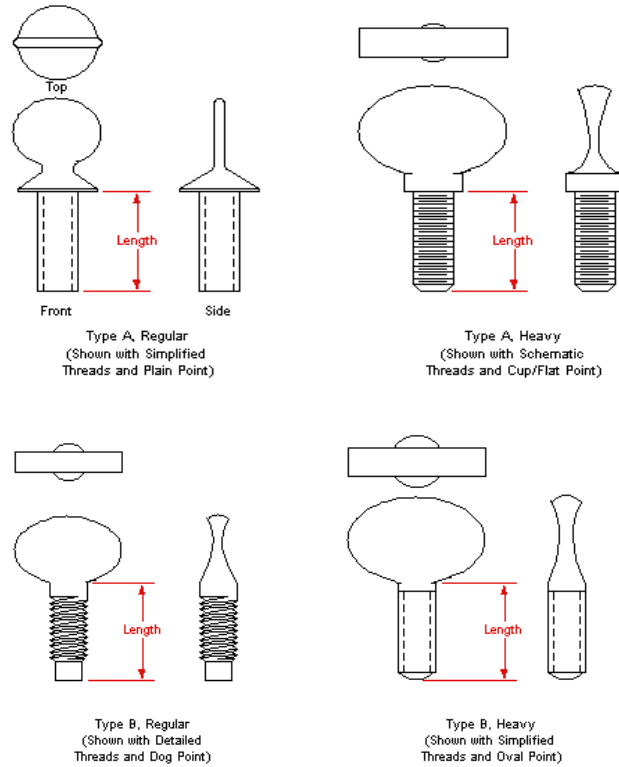
Design>Fasteners and Hardware>Shoulder Screws



Shoulder Screws

Thumb Screws

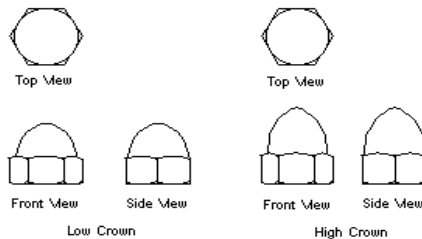
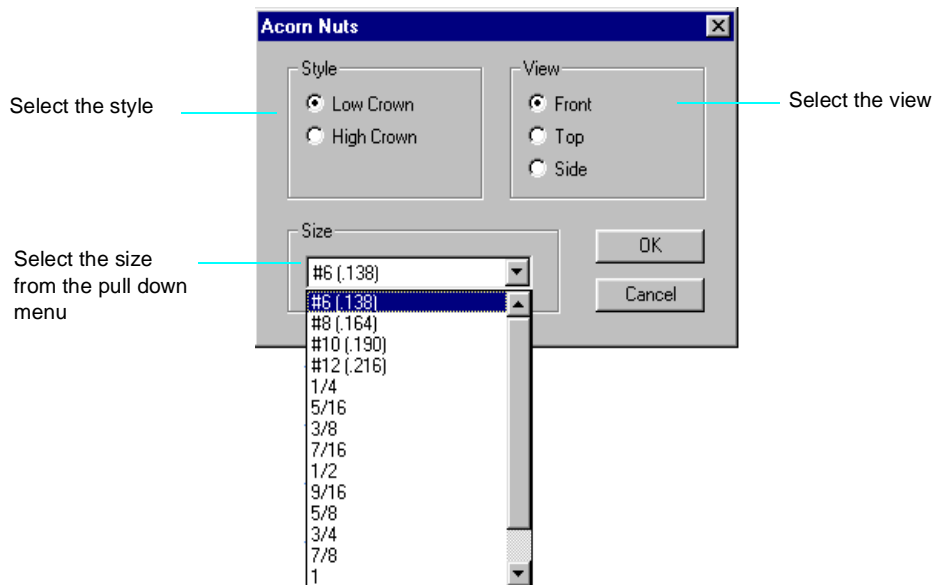
Design>Fasteners and Hardware>Thumb Screws



Thumb Screws

Acorn Nuts

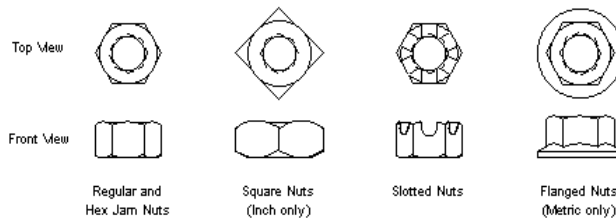
Design>Fasteners and Hardware>Acorn Nuts



Acorn Nuts

Hex Nuts - Inch

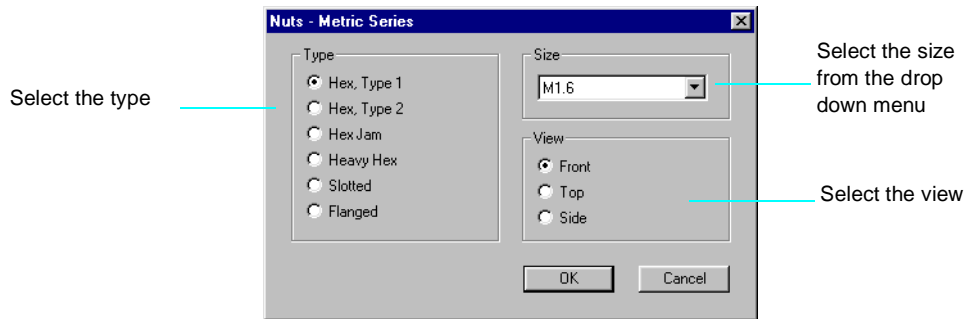
Design>Fasteners and Hardware>Hex Nuts - Inch



Nuts

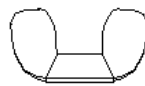
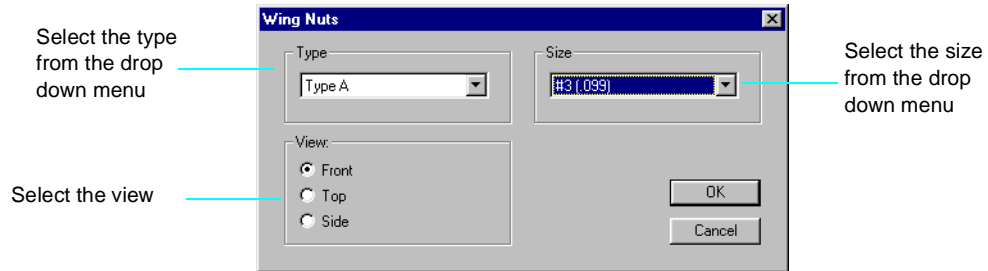
Hex Nuts-Metric

Design>Fasteners and Hardware>Hex Nuts-Metric

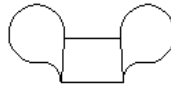


Wing Nuts

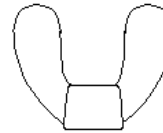
Design>Fasteners and Hardware>Wing Nuts



Type A



Type B, Style 1



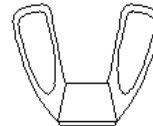
Type B, Style 2



Type C, Style 1



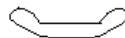
Type C, Style 2



Type C, Style 3



Type D, Style 1



Type D, Style 2



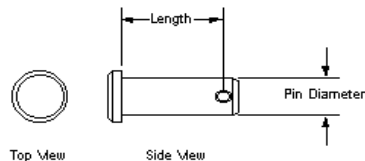
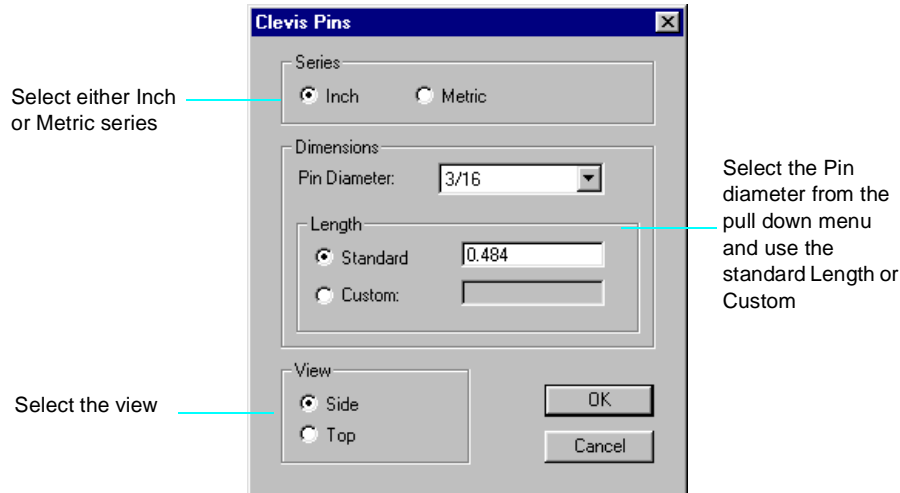
Type D, Style 3

Wing Nuts

Clevis Pins

Design>Fasteners and Hardware>Clevis Pins

The Clevis Pin command draws the top or side view of American National Standard clevis pins. You have a choice of accepting the standard length as defined by ASME standard, or inputting a custom length.

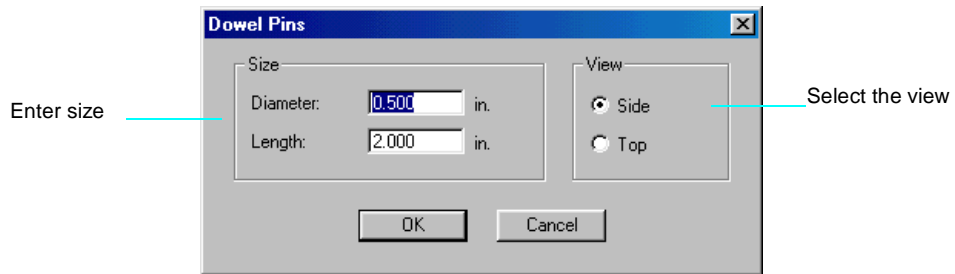


Clevis Pin

Dowel Pins

Design>Fasteners and Hardware>Dowel Pins

The Dowel Pin draws the top or side view of hardened steel dowel pins. The parameters, diameter and length, are input by you; the units will be either inches or metric, depending on the default units setting.



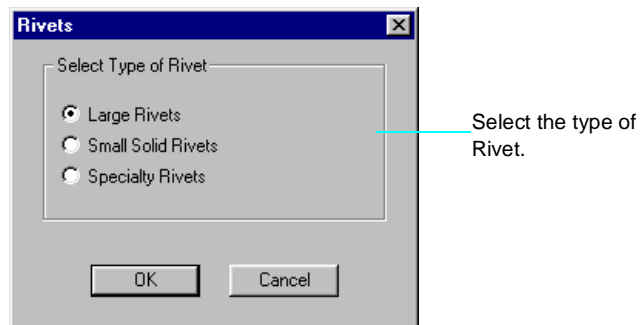
Taper Pins

Design>Fasteners and Hardware>Taper Pins

The Taper Pins command draws the top or side view of standard taper pins. The parameter length is input by you.

Rivets

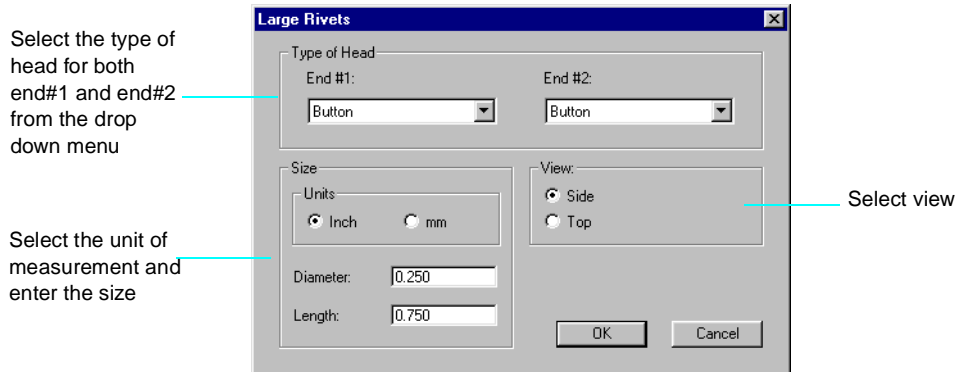
Design>Fasteners and Hardware>Rivets



Fasteners & Hardware

Mechanical Engineering Aids

After selecting the type of rivet a new dialog box will appear. Rivets are available in a variety of head styles and are classified by head type, body diameter and length. Enter the desired criteria.



Washers

Design>Fasteners and Hardware>Washers

The Washers command draws either the top or front view of ASME Type B (Inch) or Metric Plain Washers, ASME inch or metric Helical Spring Lock Washers, or plain washer with dimensions specified by the user. After selecting the type of washer from the Washer command a new dialog box will appear. Commercial plain and lock washers are specified by the screw or bolt size and are available in narrow, regular, or wide sizes for plain washers and regular, heavy, and extra duty sizes for inch lock washers and regular and heavy metric lock washers. Enter the desired criteria remembering to select bolt or screw size from the drop down menu.

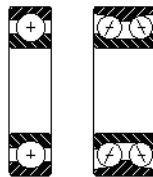
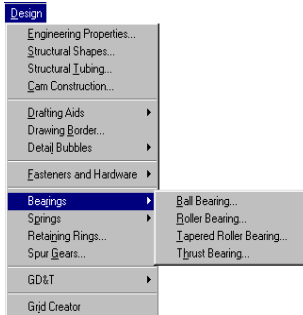
MACHINE ELEMENTS

Machine Elements are comprised of items commonly used in the design of any working machine. These items consist of various bearings, springs, retaining rings and spur gears as described in this section.

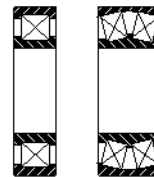
Bearings

Design>Bearings

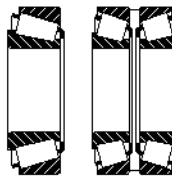
The Bearings sub-menu contains four types of bearings: Ball Bearing, Roller Bearing, Tapered Roller Bearing and Thrust Bearing. Each of these items displays a dialog box which contains various standard configurations as describe below.



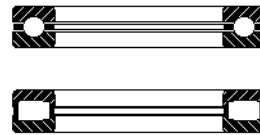
Ball Bearings



Roller Bearings



Tapered Roller



Thrust Bearings

Bearings

Ball Bearing

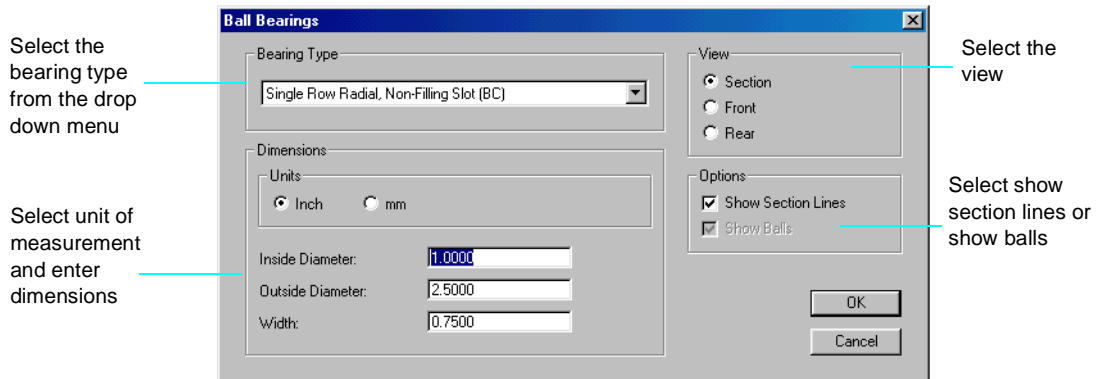
Design>Bearings>Ball Bearing

The Ball Bearing command draws either a section view or front view of 12 common types of ball bearings including: single row radial, single row

Machine Elements

Mechanical Engineering Aids

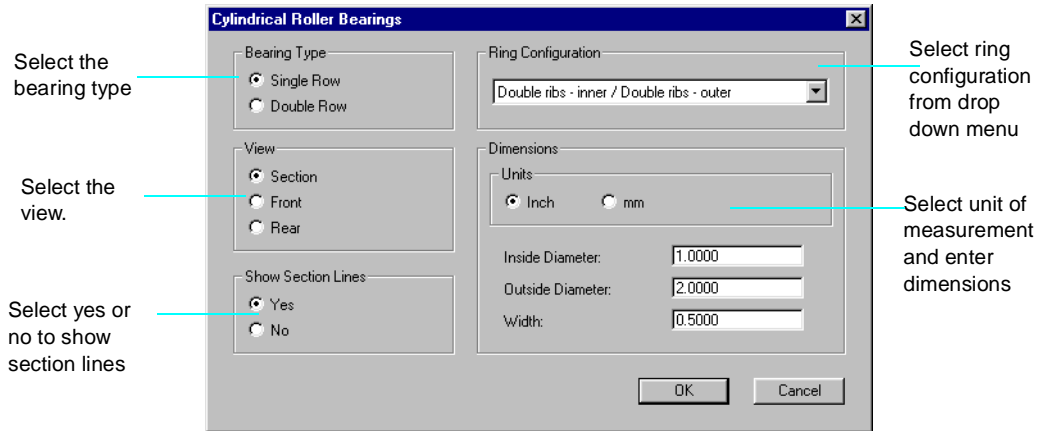
angular, double row radial, and double row angular types. The dimensions, inside diameter, outside diameter and width, are input by the user. Inches or mm can be specified regardless of the units setting of the active drawing.



Roller Bearings

Design>Bearings>Roller Bearings

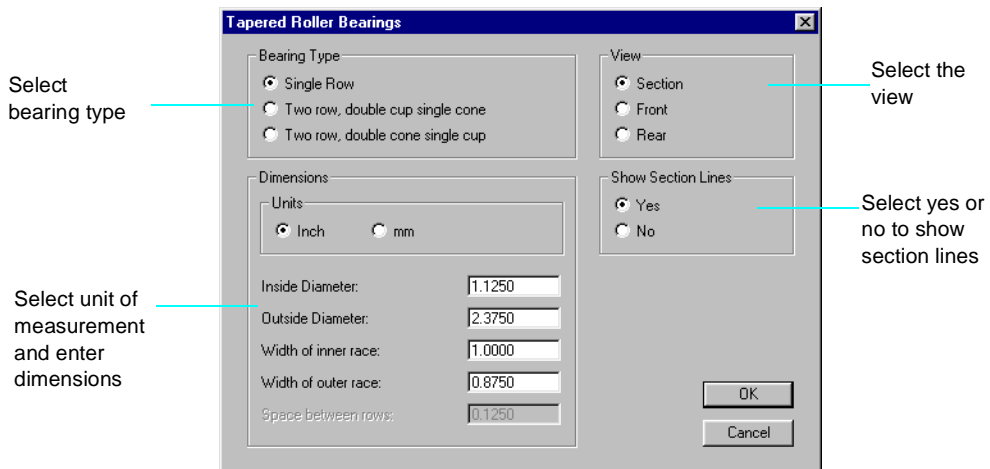
The Roller Bearing command draws either a section view, rear view, or front view of cylindrical roller bearings with 5 common types of rib configurations: Double ribs-inner/Double ribs-outer, Double ribs-inner/no ribs-outer, No ribs-inner/Double ribs outer, Self-Aligning Outer Ring, and Self-Aligning Inner Ring.



Tapered Roller Bearing

Design>Bearings>Tapered Roller Bearing

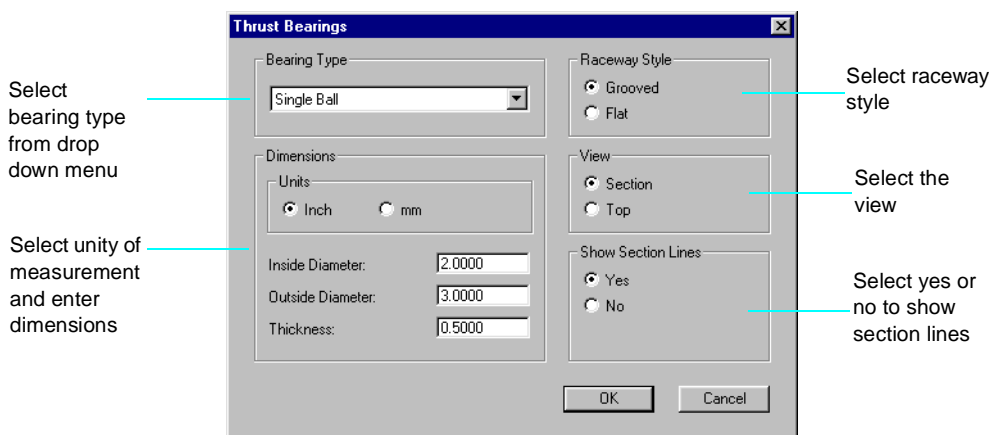
The Tapered Roller Bearing command draws the front or section view of single row and double row tapered roller bearings. The parameters outside diameter, inside diameter and width are input by the user. Inches or mm can be specified.



Thrust Bearing

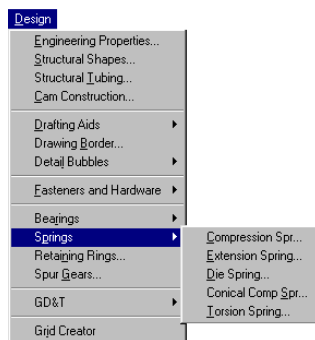
Design>Bearings>Thrust Bearing

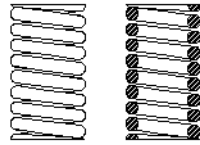
The Thrust Bearing command draws either a section view or top view of five common types of thrust bearings: Single Ball, Double Ball, Roller, Tapered Roller, or Spherical Roller. Inches or mm can be specified regardless of the units of the drawing.



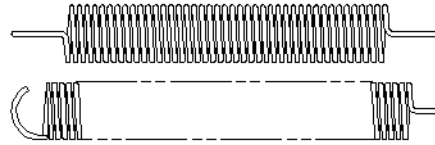
Springs

The Springs sub-menu, lists five types of springs: compression, extension, conical compression, torsion, and heavy duty die springs. A description of each type of spring follows.

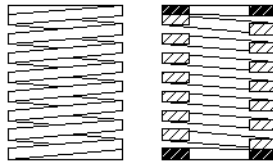




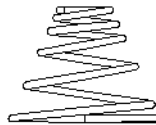
Compression Spring



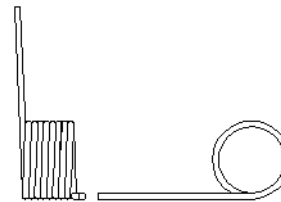
Extension spring



Heavy Duty Die
Springs



Conical
Compression
Spring



Torsion Spring

Springs

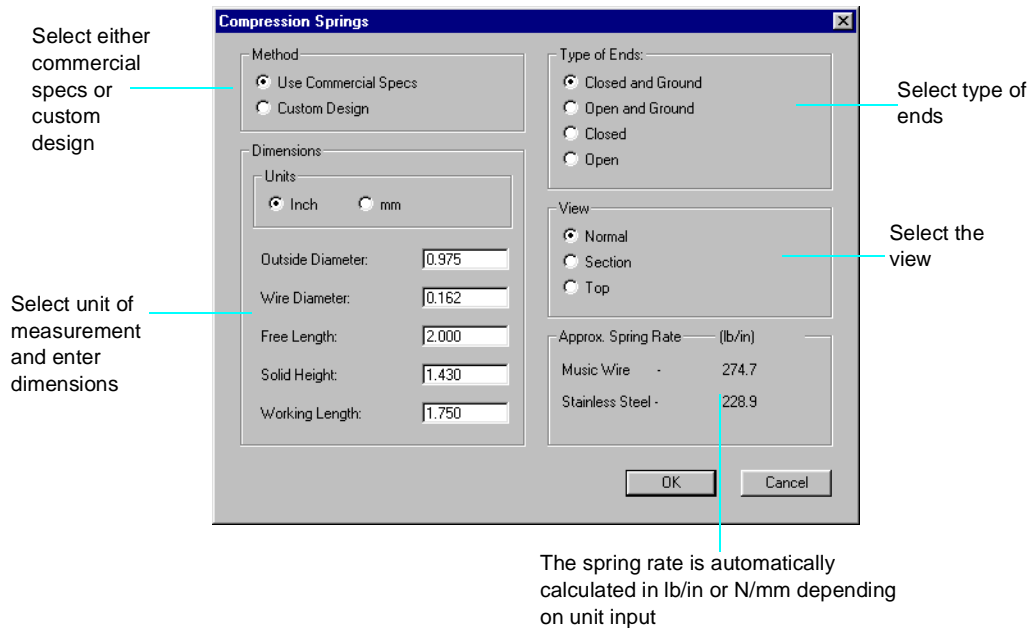
Compression Springs

Design>Springs>Compression Springs

The Compression Spring command creates a spring using dimensions found in most commercial spring catalogs or dimensions commonly used for a custom design. The approximate Spring Rate for music wire or stainless steel is calculated automatically.

Machine Elements

Mechanical Engineering Aids

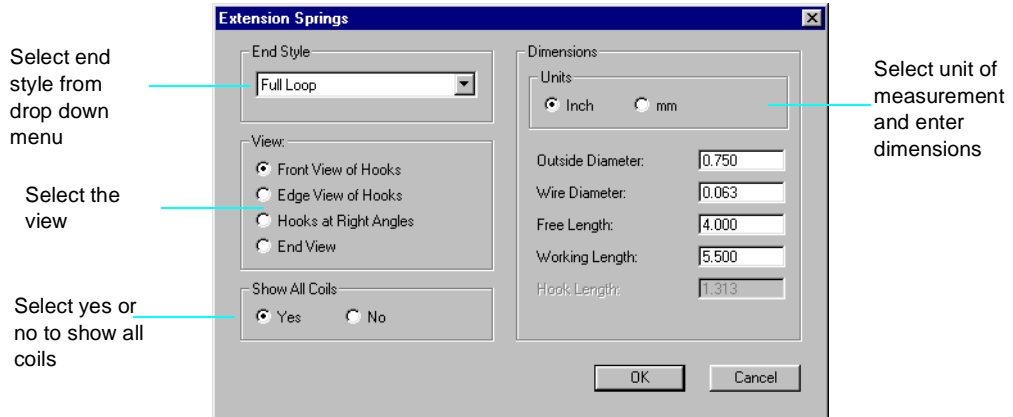


Extension Springs

Design>Springs>Extension Springs

The Extension Spring command draws four different views of seven end styles; Full Loop, Full Round Hook, Machine Loop, Machine Hook,

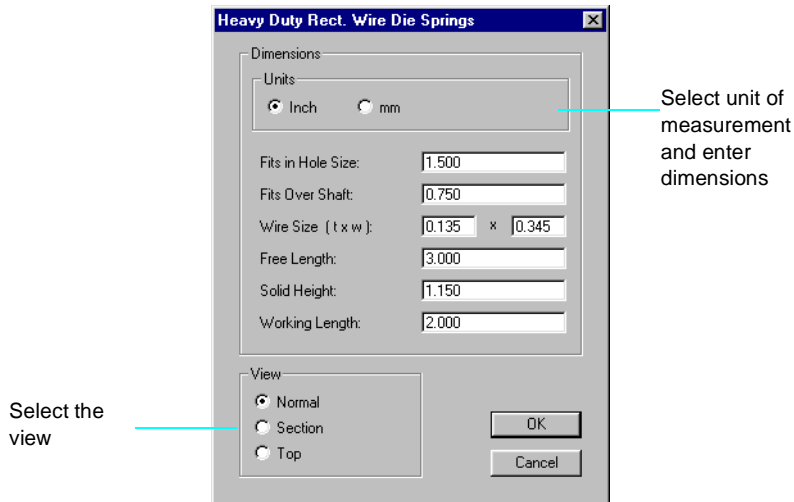
raised Hook, Rectangular Hook and V Hook. You have the option to Show All Coils or use phantom lines, instead of drawing all of the coils.



Die Springs

Design>Springs>Die Springs

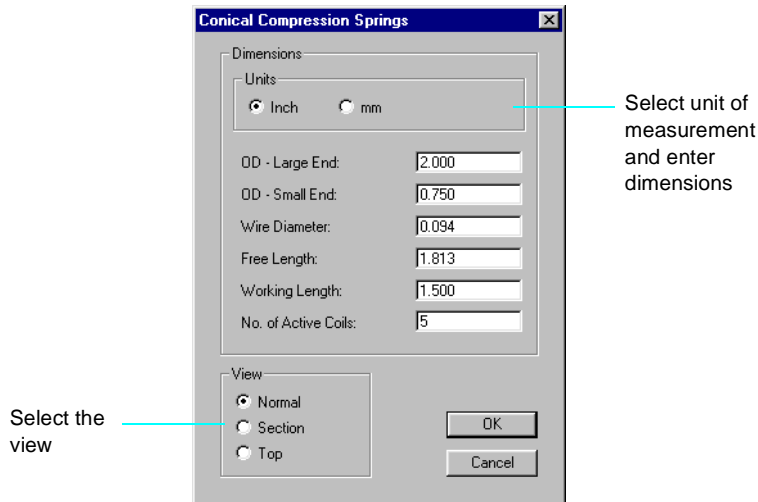
The Die Springs command draws to your specifications after entering the desired dimensions criteria. Spring specs can be found in most commercial spring catalogs. You can chose one of three views; normal, section, or top.



Conical Compression Springs

Design>Springs>Conical Compression Springs

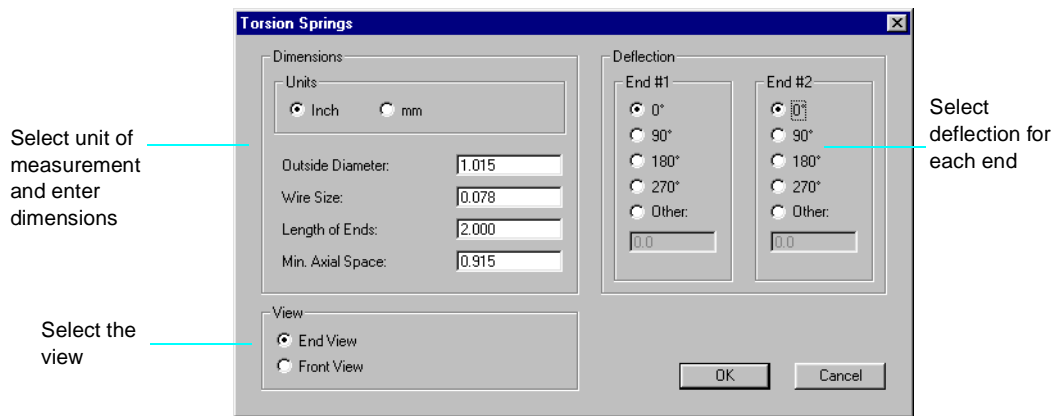
The Conical Compression Springs command draws to your specification after entering the desired dimensions criteria which can be found in most commercial spring catalogs. You can choose one of three views; normal, section, or top.



Torsion Springs

Design>Springs>Torsion Springs

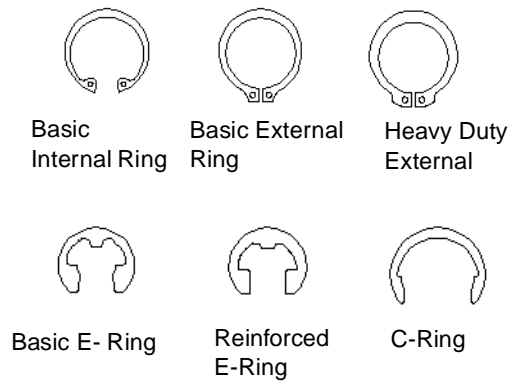
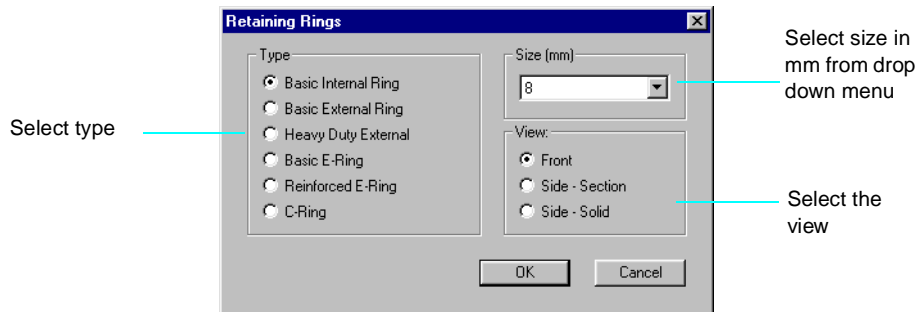
The Torsion Springs command draws to your specification after entering the desired dimensions criteria which can be found in most commercial spring catalogs. You can chose one of two views; end or front.



Retaining Rings

Design>Retaining Rings

The Retaining Rings command draws six types of retaining rings; Basic Internal Ring, Basic External Ring, Heavy Duty External, Basic E-Ring, Reinforced E-Ring and C-Ring.



Retaining Rings

Spur Gears

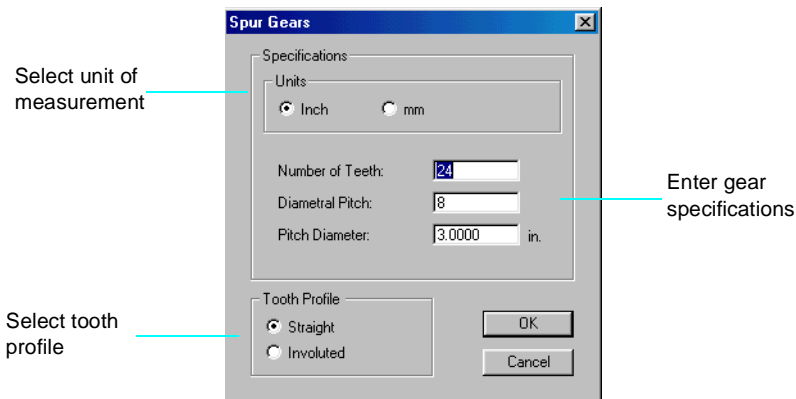
Design>Spur Gears

The Spur Gear command draws a 2-D spur gear with either straight or involuted teeth, which approximates a $14\frac{1}{2}^\circ$ involute tooth. The script requires the input of two parameters: the number of teeth and either the pitch diameter or the diametral pitch for inch sizes, or the module or the pitch diameter for metric sizes. Changing the diametral pitch or the

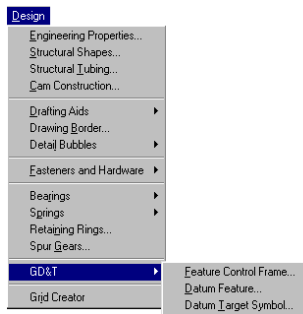
Geometric Dimensioning and Toler-

Mechanical Engineering Aids

module causes the other to be calculated and displayed in the dialog box. The gear is drawn as a polyline, so it can be extruded into a 3-D object, if desired.



GEOMETRIC DIMENSIONING AND TOLERANCING (GD&T)

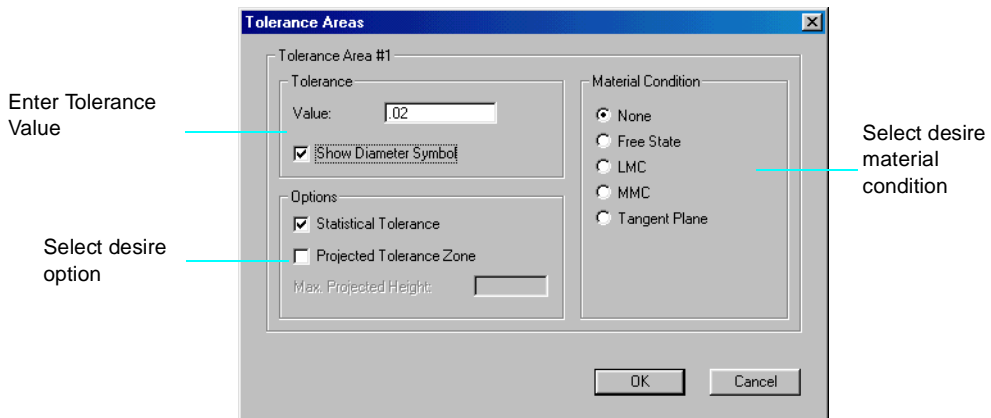
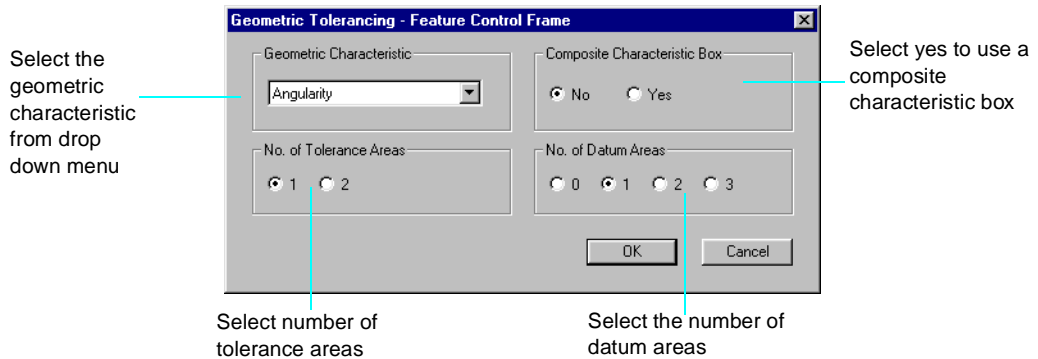


Geometric Dimensioning and Tolerancing is the process of defining design intent and functional requirements based on the application of datums, geometric controls, and modifiers.

Feature Control Frame

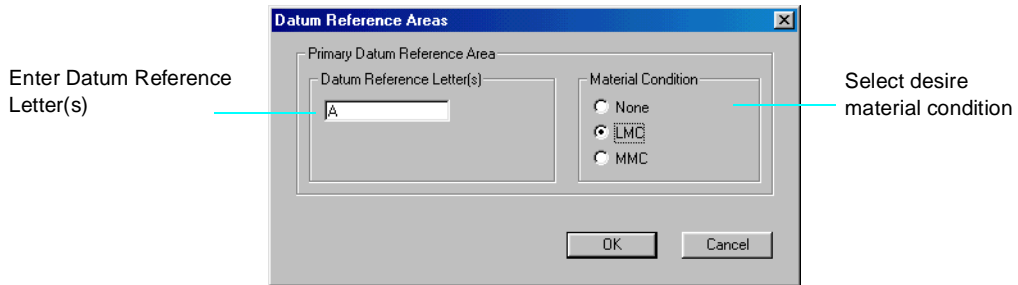
Design>GD&T>Feature Control Frame

The Feature Control Frame offers a drop down list of Geometric Characteristics used to control form, profile, orientation, location or runout. You can choose the number of tolerance and datum areas as well as a composite characteristic box which can be used with two control frames.



Geometric Dimensioning and Toler-

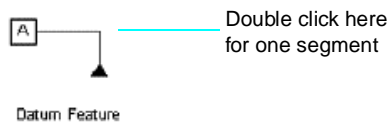
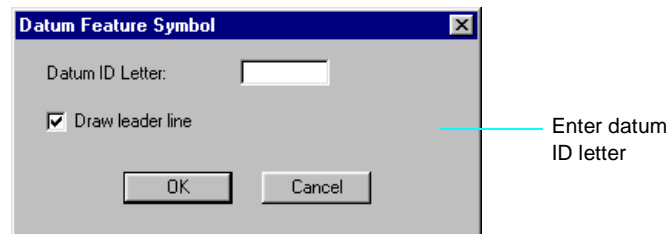
Mechanical Engineering Aids



Datum Feature

Design>GD&T>Datum Feature

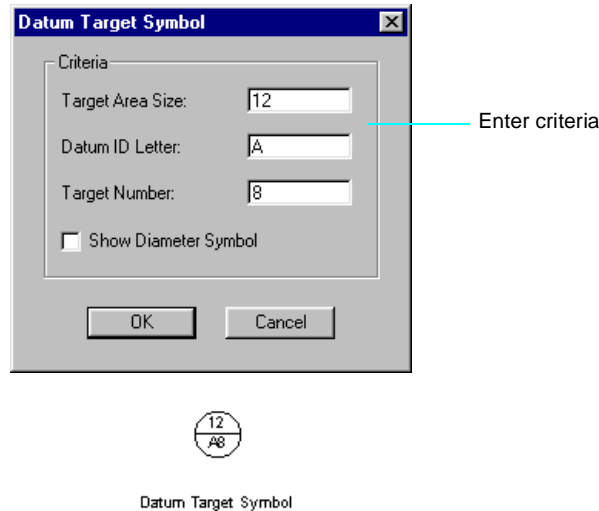
The Datum Feature assigns an ID letter used to establish a datum to an actual feature of a part. You also have the option to draw leader line. For a one segment line, double click on the end of the first segment.



Datum Target Symbol

Design>GD&T>Datum Target Symbol

The Datum Target Symbol specified the target area size, datum ID letter and target number on an object used to establish a datum. You have the option to show diameter symbol.



DETAIL BUBBLES

Design>Detail Bubbles

Detail Bubbles or balloons with leader lines, are used to assign each part of an assembly drawing a detail number that is keyed to an attach record and a linked text field. These commands were developed to be used with the Mechanical Engineering templates in the Resource Palette, but can also be used alone to create a detail bubble symbol.

Create Detail Bubbles

Design>Detail Bubbles>Create Detail Bubble

The Create Bubble command establishes the criteria for bubble format.

To create a detail bubble symbol

Detail Bubbles

Mechanical Engineering Aids

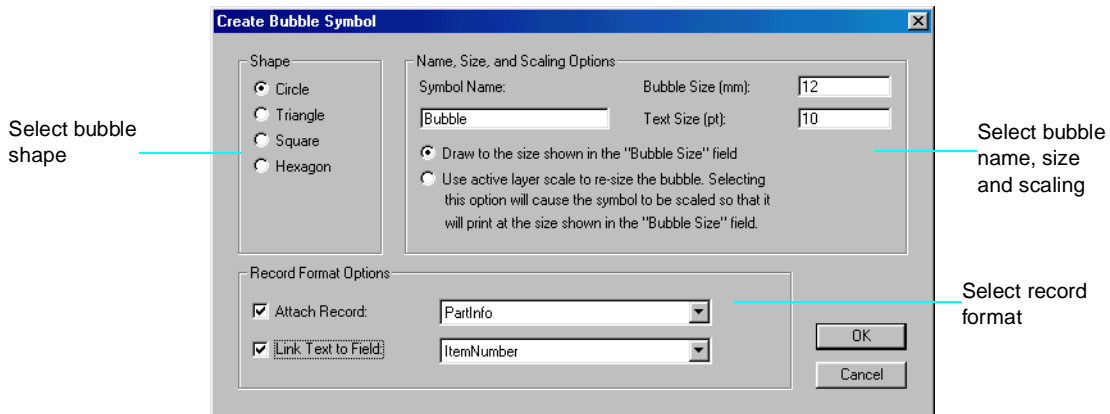
1. From the Design menu, select **Detail Bubbles>Create Detail Bubble**.
2. Select the desired shape; Circle, Triangle, Square, or Hexagon.

Select Name, Size, and Scaling Options.

Select Record Format Options.

Type in a name for the symbol, its size, and the point size for the text in the bubble. If the drawing is at a scale other than 1:1, select the "Use active layer scale to re-size...." option to scale the bubble so it will be drawn and print at the size shown in the Bubble Size field.

The text in the bubble and field of record can be linked so that when it is entered into the field it is displayed in the bubble.



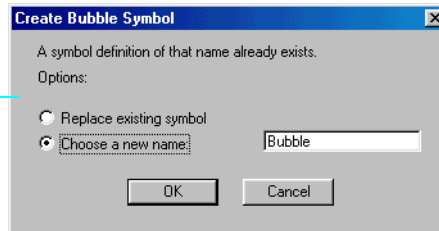
Note: For more information on records, (refer to page 15-20, Using the Database Functions, in the MiniCAD VectorWorks User's Manual).

3. Click **OK**.

Your bubble symbol has been created and added to the symbol folder of the current drawing.

Note: If a symbol definition of the same name already exists, a dialog box will appear giving you the option to replace existing symbol or choose a new name.

Select to replace existing symbol or rename. Enter symbol name in text box.



4. Add the Detail Bubble to the drawing. See “To Add Detail Bubbles” on page 33.

Add Detail Bubbles

Design>Detail Bubbles>Add Detail Bubble

The Add Detail Bubble command will prompt you to select the bubble symbol and record format to use for the detail bubble. If there is more than one record attached to the bubble symbol, select the one whose fields you want to supply information too.

Note: If there are no records attached to the bubble symbol the command will not work.

To Add Detail Bubbles

1. From the Design menu, select **Detail Bubbles>Add Detail Bubble**.

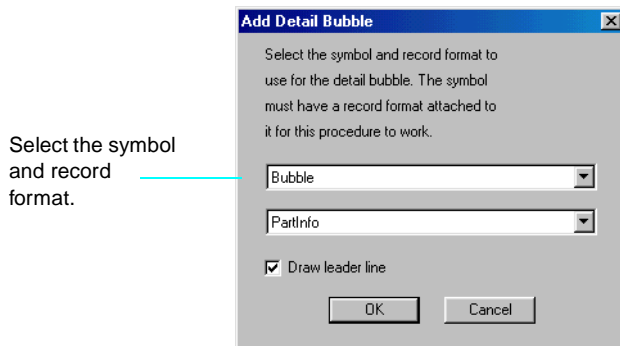
Note: The symbol must have a record format attached to it for this procedure to work.

2. Select the symbol and record format to use for the detail bubble.

Detail Bubbles

Mechanical Engineering Aids

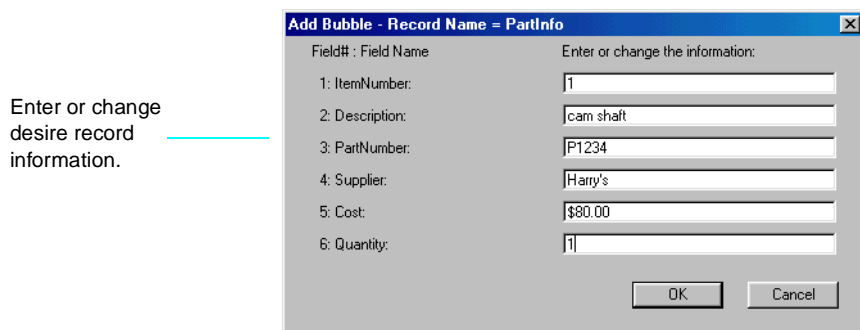
Check, Draw leader line, if you desire a leader line from your bubble.



3. Click **OK**.

The Add Bubble - Record Name dialog box appears with your record name in the title bar and all of the fields, along with the default values, will be displayed.

4. Enter or change the information in the record dialog box.



5. Click **OK**.

6. Place your cursor at the desired location for the bubble on your drawing and click. Your detail bubble will appear. If **Draw Leader Lines** was selected drag your cursor to the desired point and click again to drop.

A Notice dialog box will appear prompting you to insert another bubble. If you are creating another bubble, click yes, and repeat steps 3 through 6.

If you are using any of the Mechanical Engineering templates, after all bubbles are placed on your drawing with all information entered into the fields, it is simple to create both a Parts List and a Bill of Materials. The

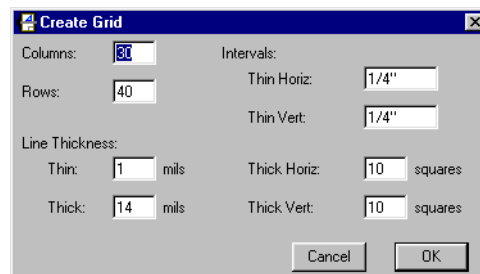
parts list is generated using the worksheet named Part List. Open the worksheet from the Resource Palette or worksheet command in the Windows menu, and use the worksheet Recalculate command. The database is set to display the Item#, Description, and Quantity fields (refer to section 15, Using Worksheets and Databases, in the VectorWorks User's Manual for more information on setting up and using worksheets and databases). The advantages to working with VectorWorks worksheets is you can create, use, and add information to these worksheets without leaving the drawing area.

The process is identical for creating a Bill of Materials. Open the Bill of Materials worksheet and use the Recalculate command. The worksheet should show all information called for in the database. Through the Resources palette, you can also paste a worksheet into a drawing as a graphic.

GRID CREATOR

Design>Grid Creator

The Grid Creator command draws to your specifications a grid. You can choose the horizontal and vertical grid intervals using the Thin Horiz and Thin Vert values and place thick lines at the intervals specified by Thick Horiz and Thick Vert.



Enter desired grid criteria

